IRI Multi-Model Ensemble Activities

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Outline

1. 2-Tier MME
   a. Current System (Distributed)
   b. Historical Skill
   c. New Tools for Users
   d. Research: CTB
2. 1-Tier MME
   a. Current System
   b. Bayesian versus Pooling with short data record
3. Use of Forecast Information in sectoral applications in developing world
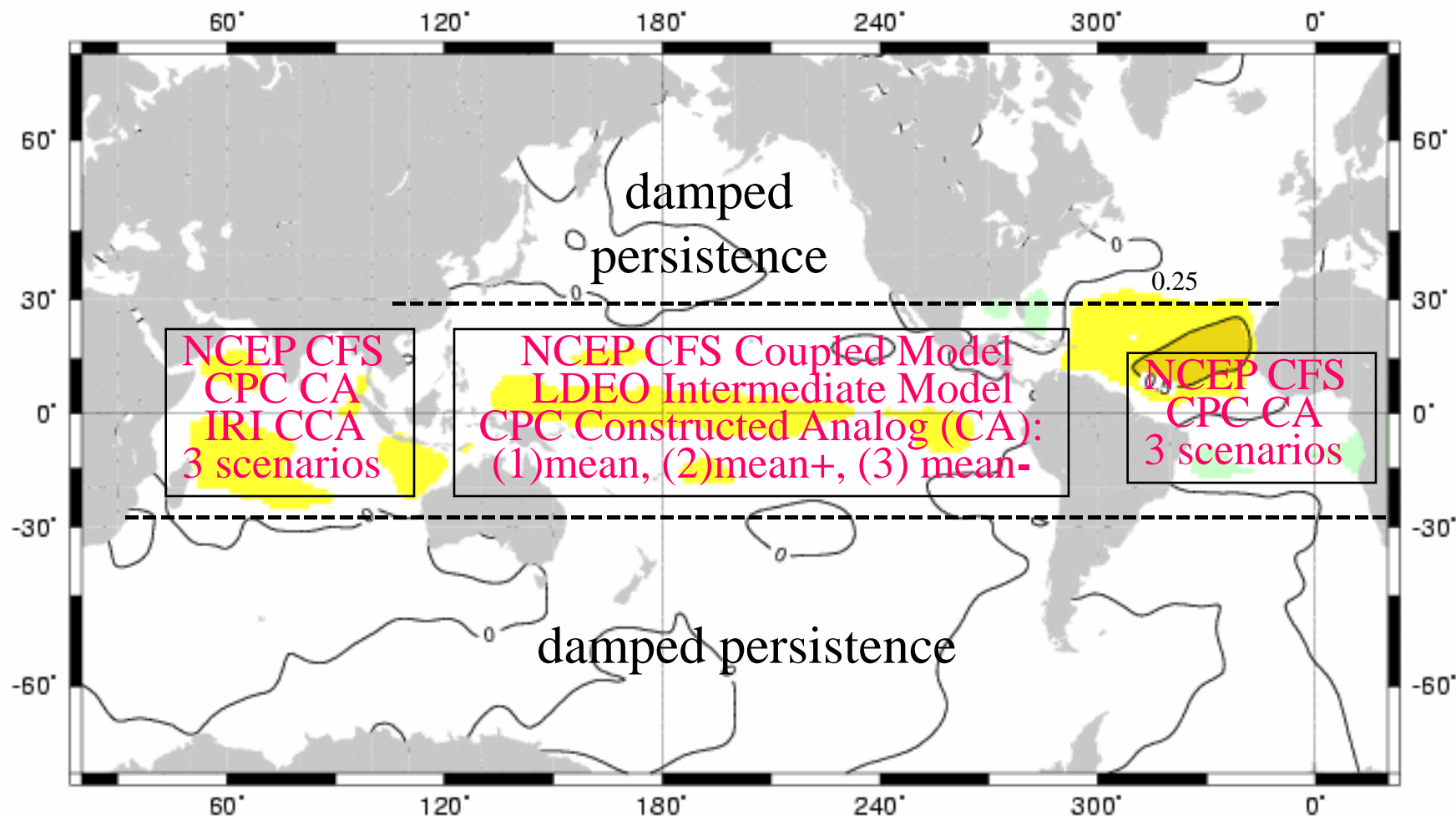4. Future directions
5. More details if time permits

IRI's 2-Tiered Climate Forecasting System in 2010

IRI 2-Tier Forecast Methodology

- Atmospheric GCMs forced with forecast SST scenarios
  - Mean of CFS, CA and LDEO
  - Positive and negative perturbations based on historical error
- Pattern-based correction of individual model ensemble means.
  - Regression based on historical model runs
    - Forecast SST (CA)
    - Observed SST
  - Spread estimate from historical forecasts with forecast SST.
- Equal weighting of corrected models
- Forecast probabilities
  - Gaussian distribution for temperature
  - Transformed Gaussian for precipitation

Method of Forming 3 SST Predictions for Climate Predictions

damped persistence

0.25

NCEP CFS
CPC CA
IRI CCA
3 scenarios

NCEP CFS Coupled Model
LDEO Intermediate Model
CPC Constructed Analog (CA):
(1)mean, (2)mean+, (3) mean-
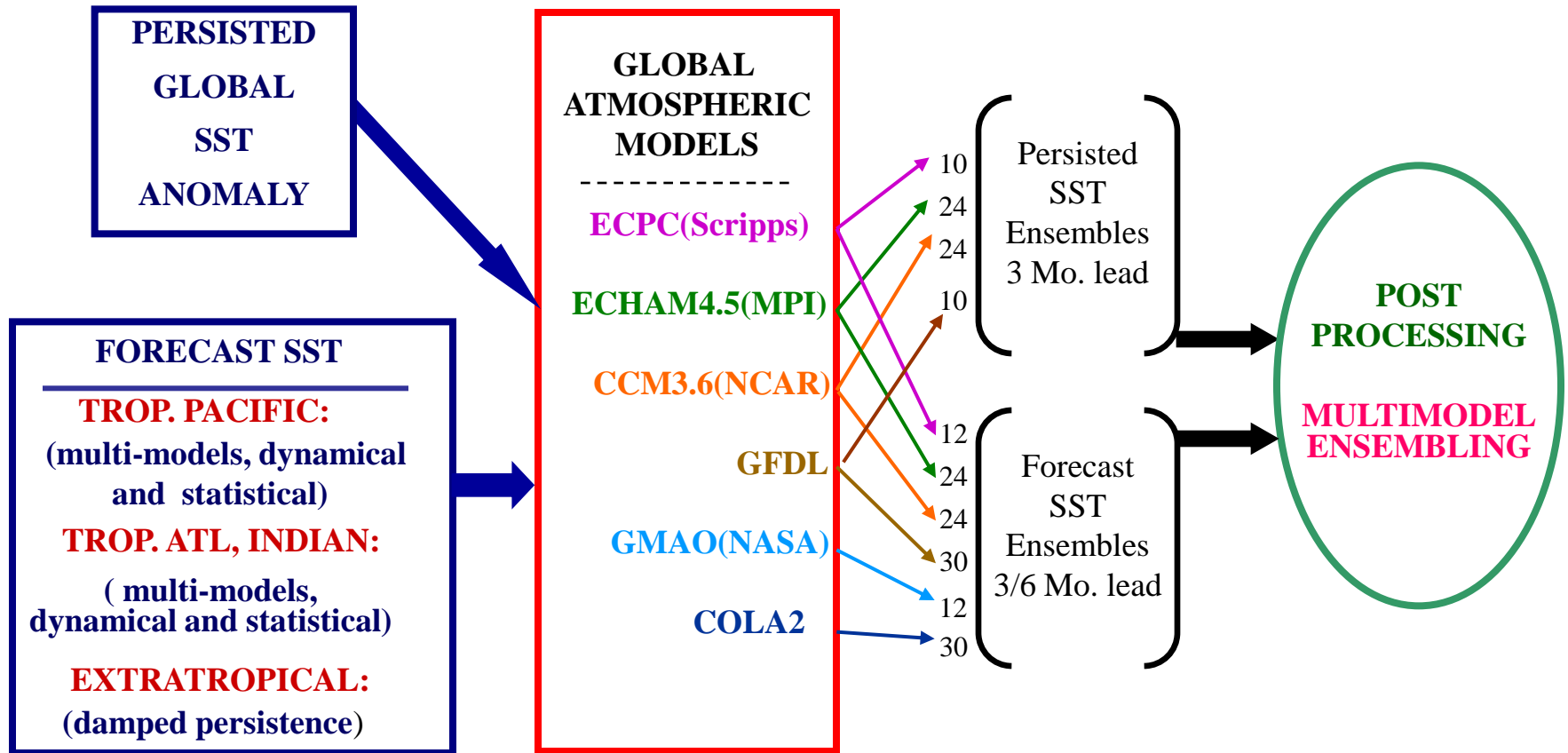
NCEP CFS
CPC CA
3 scenarios

damped persistence

For each ocean basin, the 3 SST scenarios are (1) mean of the models used for that basin, (2) mean+p and (3) mean-p
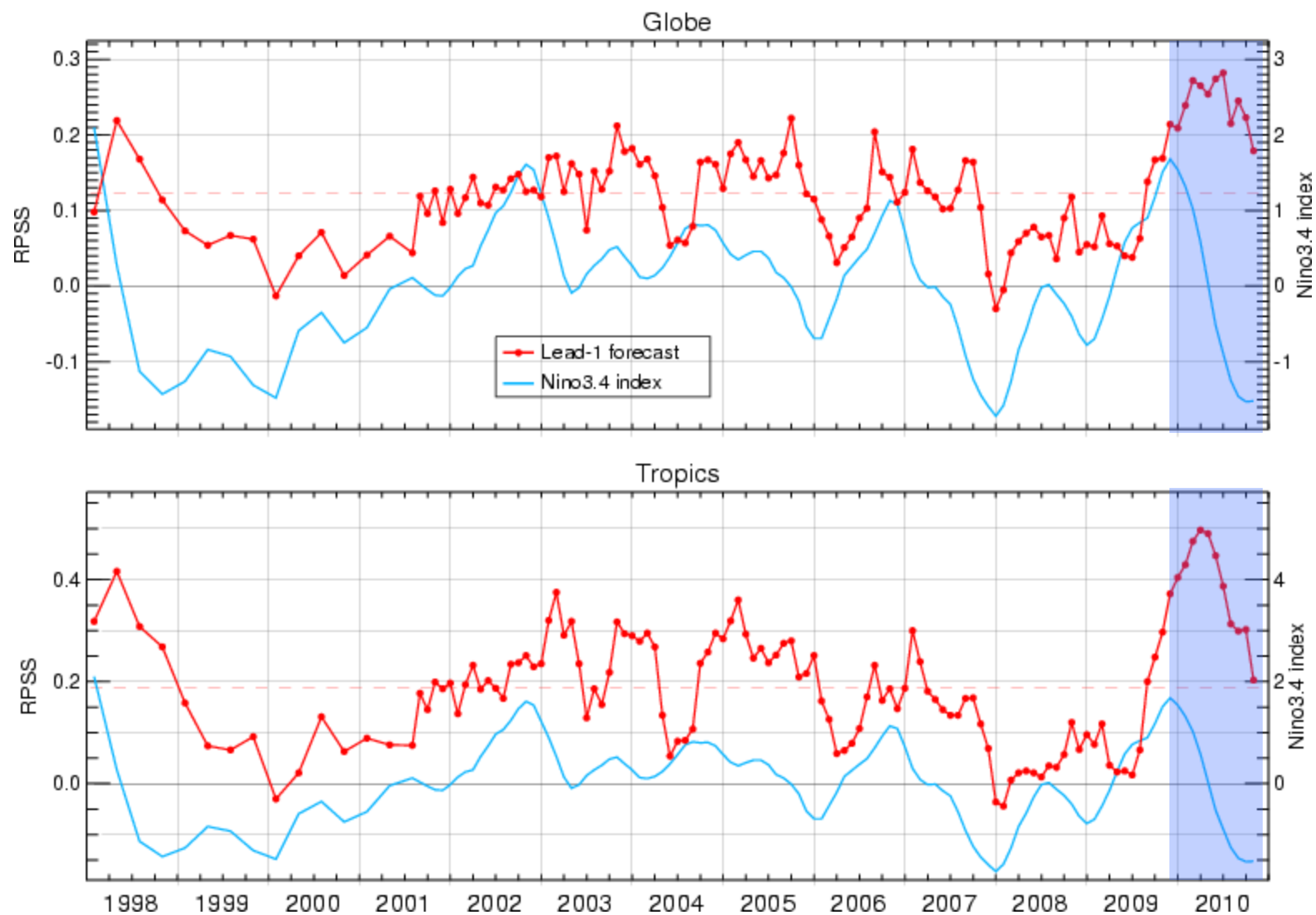p is uncertainty factor from 1st EOF of model historical error

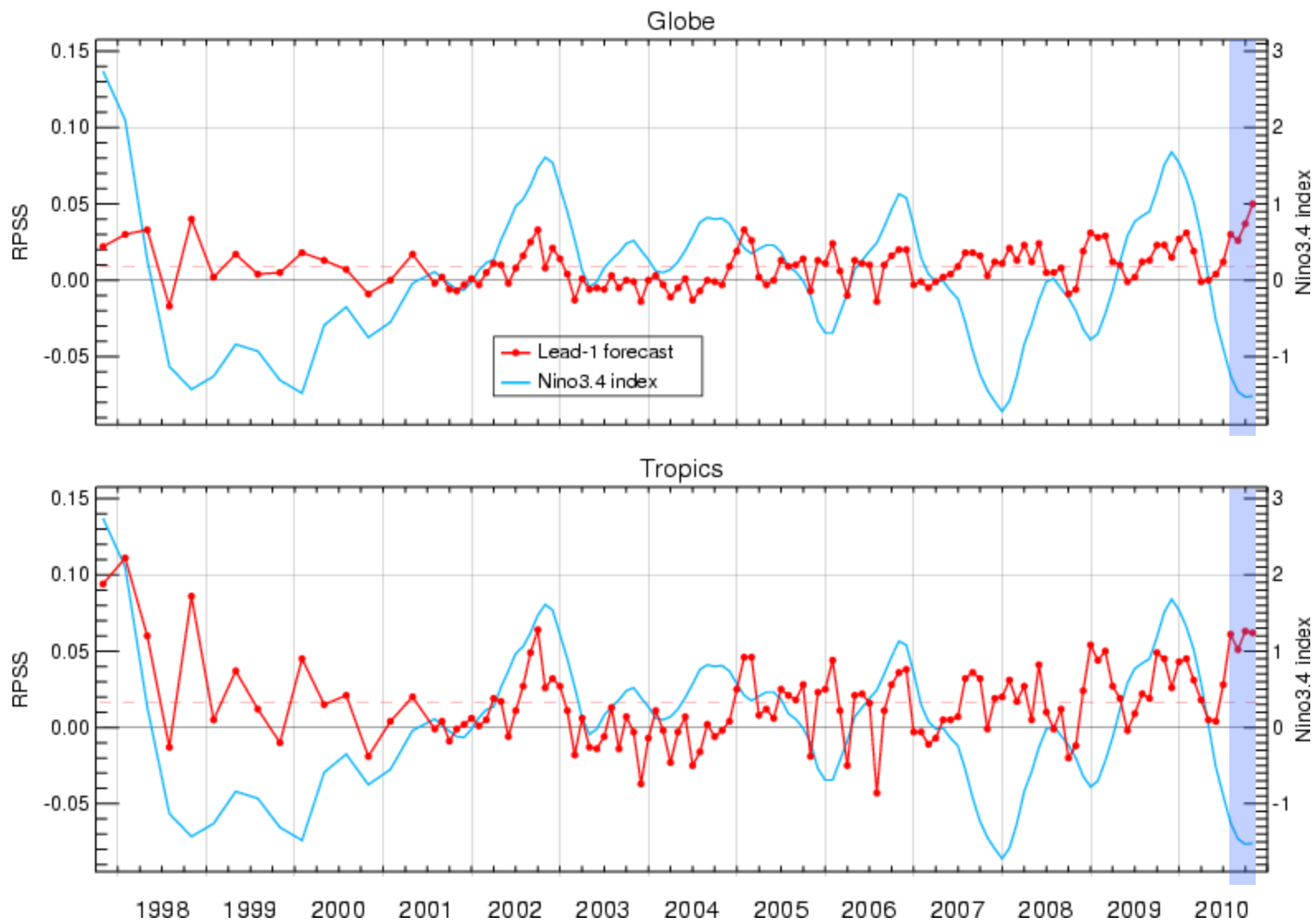# IRI DYNAMICAL CLIMATE FORECAST SYSTEM

2-tiered

OCEAN   **ATMOSPHERE**

PERSISTED GLOBAL SST ANOMALY

FORECAST SST

TROP. PACIFIC:
(multi-models, dynamical and statistical)

TROP. ATL, INDIAN:
(multi-models, dynamical and statistical)

EXTRATROPICAL:
(damped persistence)

GLOBAL ATMOSPHERIC MODELS

ECPC(Scripps)

ECHAM4.5(MPI)

CCM3.6(NCAR)

GFDL

GMAO(NASA)

COLA2

10
24
24
10

Persisted SST Ensembles 3 Mo. lead

12
24
24
30
12
30

Forecast SST Ensembles 3/6 Mo. lead

POST PROCESSING

MULTIMODEL ENSEMBLING

Time Series of RPSS: Temperature (Lead-1)

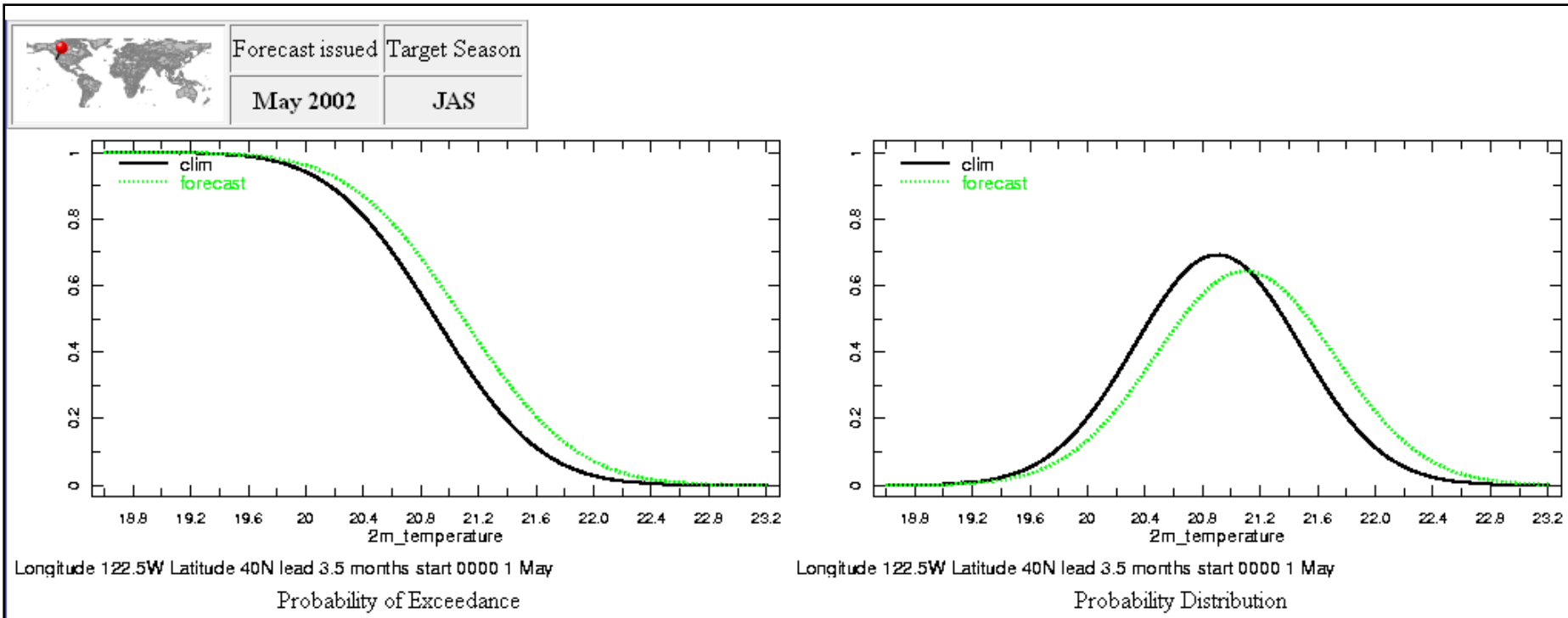Globe

Tropics

Time Series of RPSS: Precipitation (Lead-1)

Reliability Diagram – IRI Precipitation Forecasts

(a) Global Precipitation

(b) Tropical Precipitation
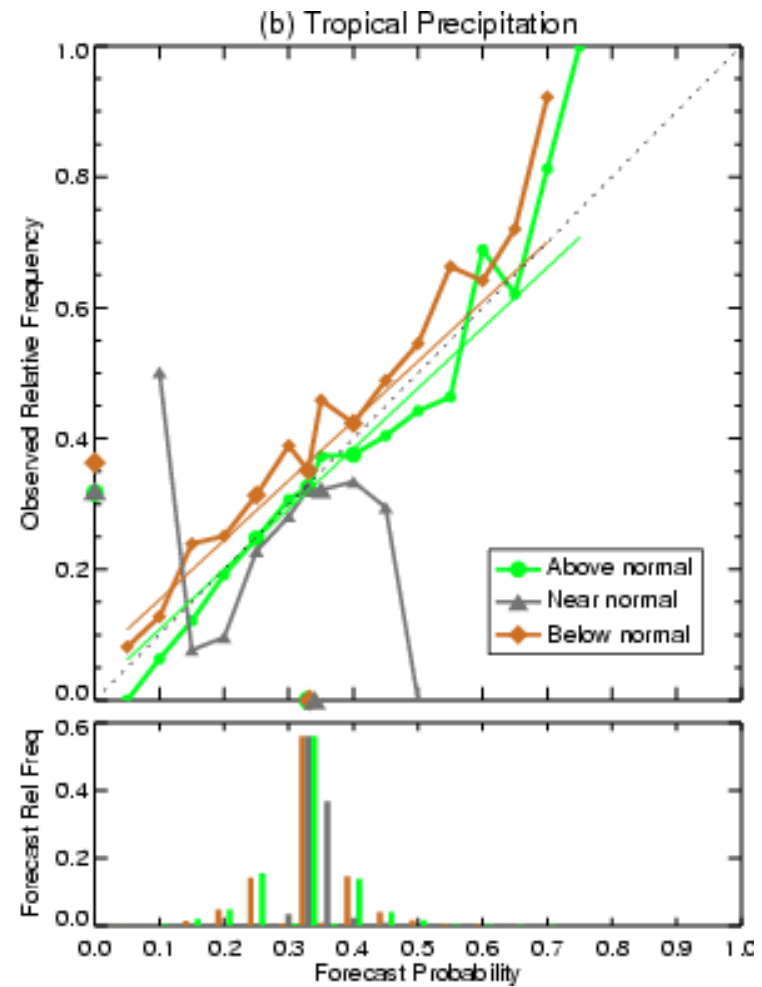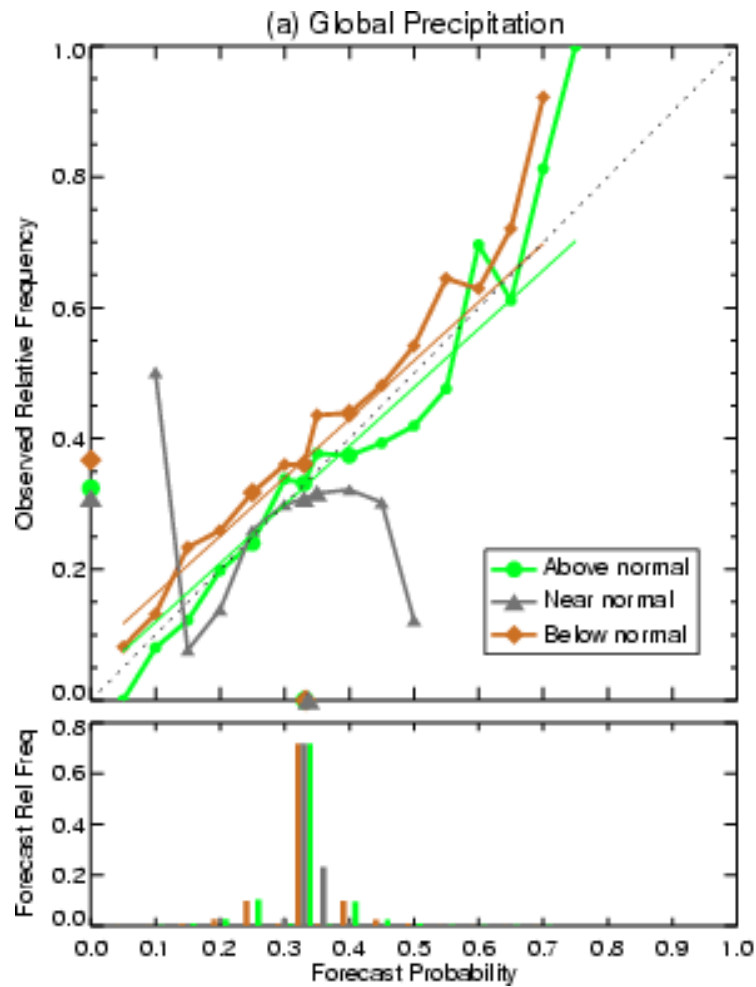
# Reliability Diagram – IRI Temperature Forecasts
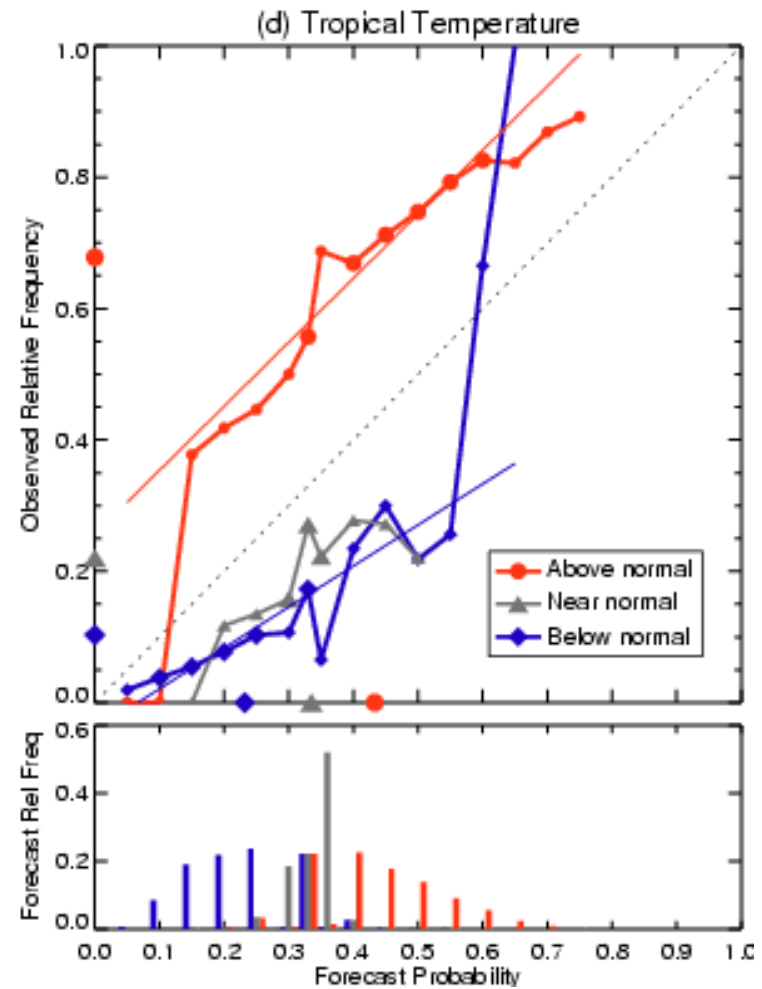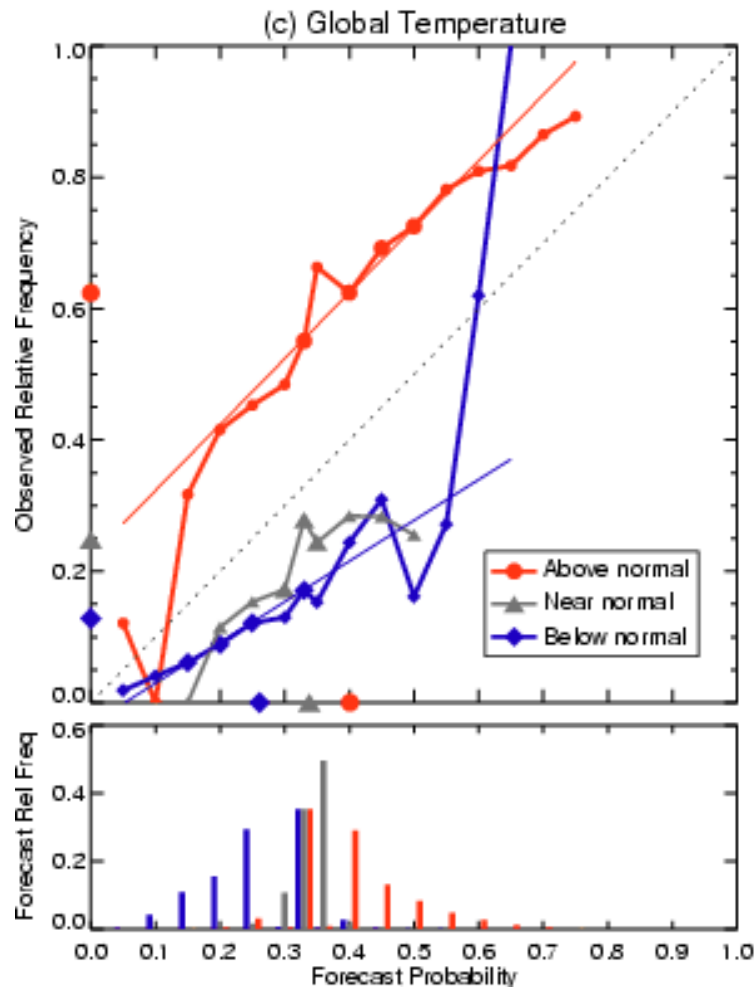
Flexible format map room

CTB supported work

- "Recalibrating and combining ensemble predictions"
  - Pattern-based correction of model output
    - Are regression forecasts reliable?
    - How are patterns selected?
  - Information beyond terciles
  - Results being incorporated into IRI Net Assessment methodology
- "Incorporating scale and predictability information in multimodel ensemble climate predictions"
  - Using spatial and predictability information in the calculation of multimodel weights

Coupled MME Forecast System
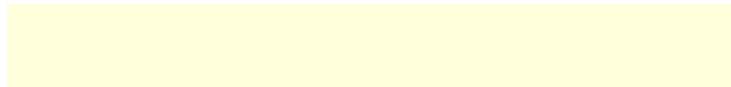
1-Tier Experimental Multi-Model Ensemble

Models:

ECHAM-DC2

ECHAM-AC1

ECHAM-GML

NCEP-CFS

Hindcasts from 1982 to present.

Simple pooling MME. Found to be (slightly) superior to Bayesian combination. But still exploring other combination schemes.

Forecasts are available on the web.

Forecast over US is CPC forecast.

Next step is to combine with 2-tier forecasts.

Skill Comparison: Bayesian Versus Pooling
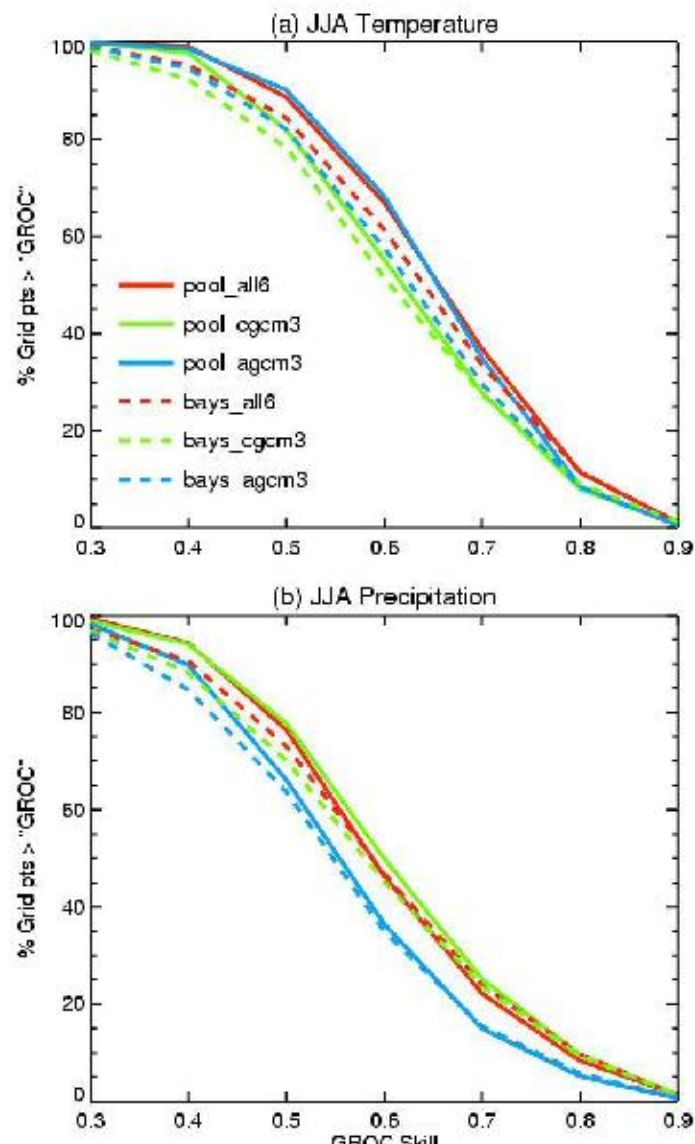
(a) JJA Temperature

(b) JJA Precipitation

IRI produces a variety of sectorally based seasonal forecast products.

Inputs can come from globally optimized solutions (Global MME) or locally optimized solutions (examples shown).

Sectoral collaborators will pick the solution that works best for them. One size does not fit all.**

Possible for IRI to leverage US National MME products as additional tools for sectoral scientists to choose from.

IRI MME Future Directions

1. Explore combined MME with 2-tier and 1-tier models.

2. Climate Test Bed projects.

3. Continue Development of "Locally Optimized"

    MMEs in regionally specific sectoral contexts which use local observed data for MOS correction and downscaling.

4. Work with others to help develop National MME and apply these models in applications contexts.

    a. MOS correction.

    b. Model weighting.
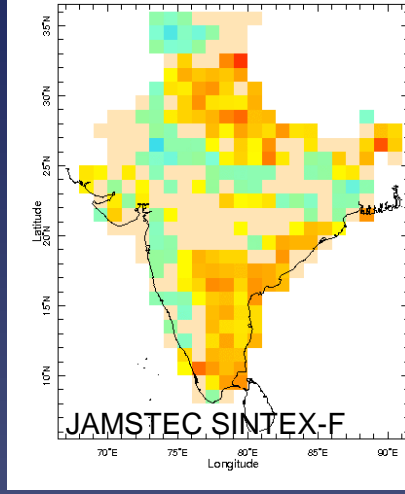
    c. User tools including retrospective skill evaluation

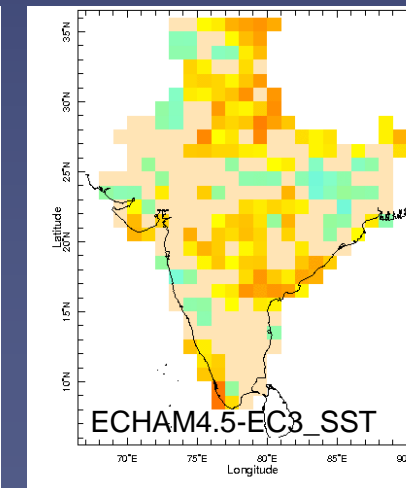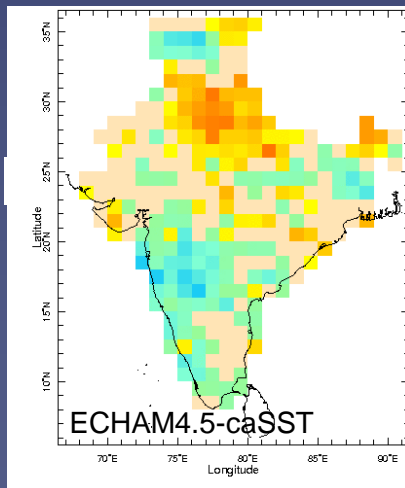# CSIR Downscaled Streamflow Forecast for South Africa (Local Optimization) Willem Landman
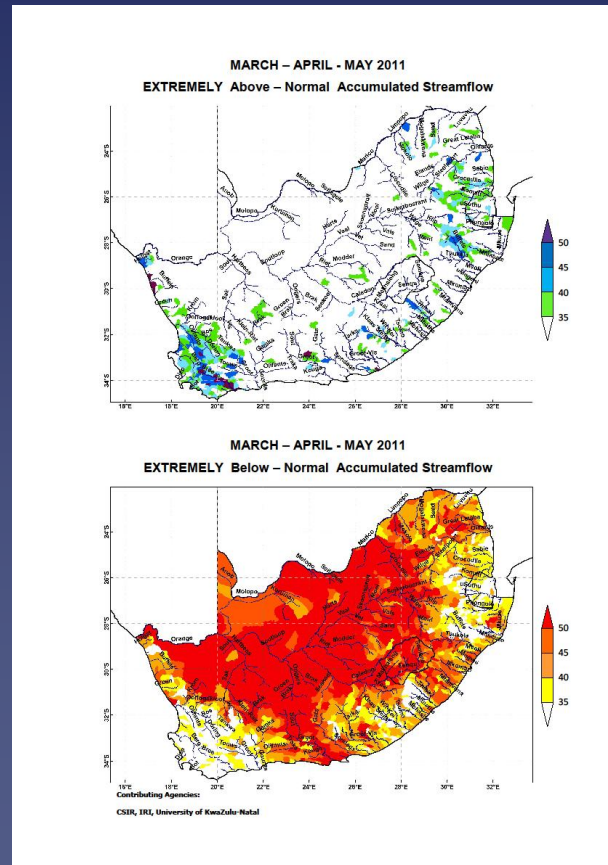
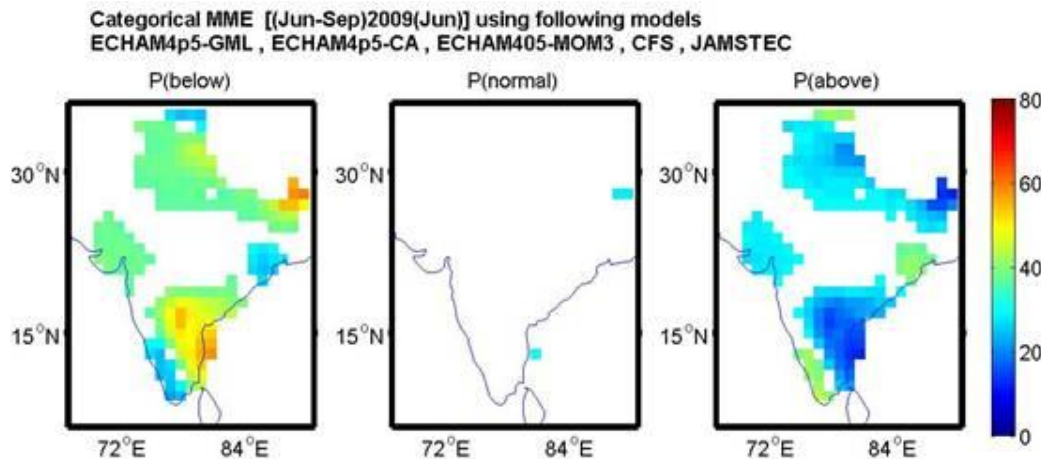# Intercomparison of GCM precipitation seasonal forecast skill
Anomaly correlation
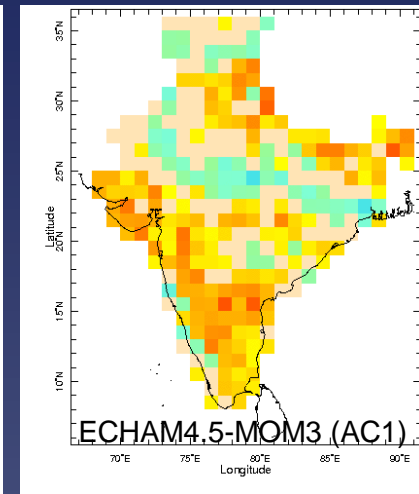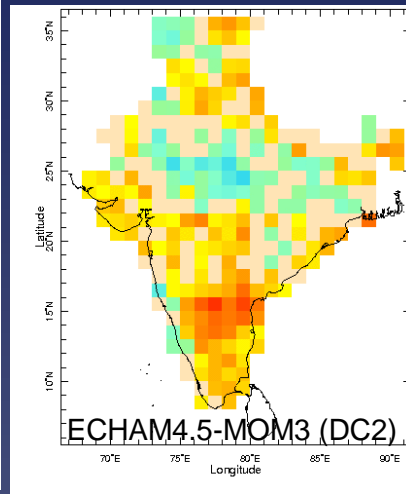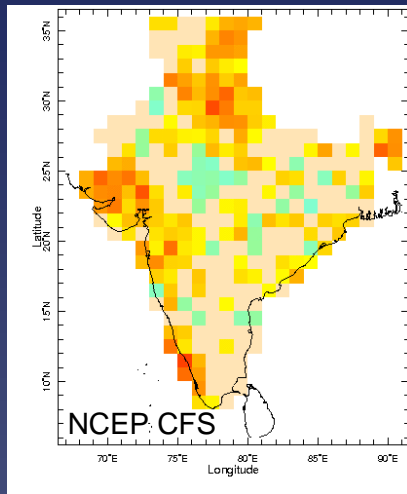
June–Sept Seasonal total from May 1 (1982–08)
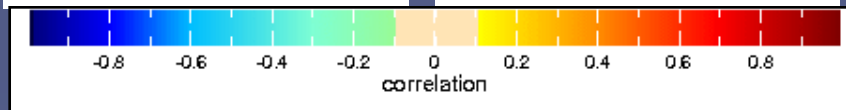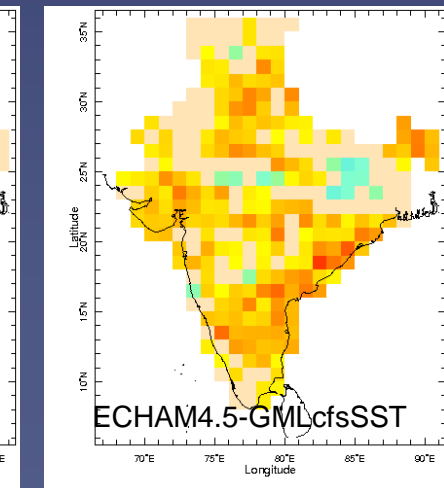
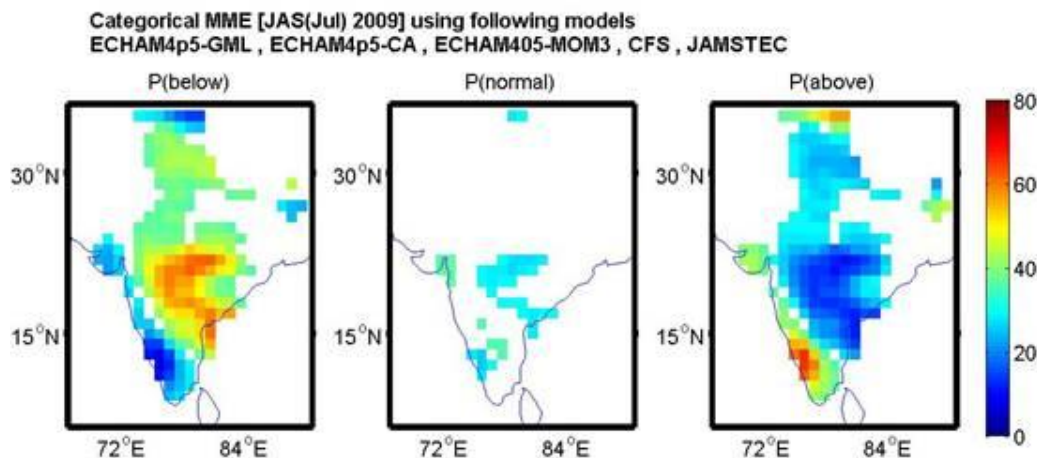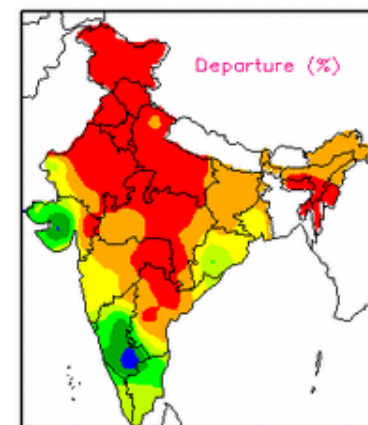# 2009 MME Precip Real-Time Forecasts for IndiaMade by ERFS project at IIT-Delhi

Categorical MME [(Jun-Sep)2009(Jun)] using following models
ECHAM4p5-GML , ECHAM4p5-CA , ECHAM405-MOM3 , CFS , JAMSTEC

JJAS(Jun 1)

Obs-JJAS

Categorical MME [JAS(Jul) 2009] using following models
ECHAM4p5-GML , ECHAM4p5-CA , ECHAM405-MOM3 , CFS , JAMSTEC

JAS (Jul 1)

5 GCMS: CFS, JAMSTEC, ECHAM4.5-caSST, ECHAM4.5-GML, ECHAM4.5-MOM3

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